Interim Guidance
05/08/97

U. S. DEPARTMENT OF ENERGY
STANDARD OPERATING PROCEDURES
TITLE
OFFICE OF SCIENCE AND TECHNOLOGY
TECHNOLOGY DECISION PROCESS

Procedure No.: _____ Revision No.: _____ Date: _____ Page: _____

Concurrence: _____ Deputy Assistant Secretary Approval: _____

1. PURPOSE

The purpose of this procedure is to describe a process for evaluating and managing the transition of environmental technologies/systems from research to development, demonstration, and implementation.

2. SCOPE

This procedure describes the formal process for using the Office of Science and Technology (OST) Technology Decision Process. It specifies criteria, requirements, and deliverables to provide a common basis for technology assessment and management at the decision points. It identifies responsibilities for each activity and the organization/individual responsible for preparing supporting documents, and it provides a system to determine the merits of technical and program activities throughout the life of the technology under development.

The procedure applies to Department of Energy (DOE) Office of Environmental Management (EM-50) personnel performing technology development tasks and activities. It may also apply to other Department of Energy (DOE) organizations or contractors to the extent invoked by contract or other appropriate written agreement or direction.

3. REQUIREMENTS, REFERENCES, AND DEFINITIONS

3.1 Requirements

3.1.1 *EM-50 Management Policies and Requirements*, May 1992
3.1.2 *EM-50 Management Plan*, December 1992

3.2 References

See Attachment A.

3.3 Definitions

See Attachment B.

4. GENERAL REQUIREMENTS

4.1 Basic Assessment and Management Procedures

This procedure is a tool to be used by the Focus Area/Crosscutting Programs/Industry Programs (FA/CC/IP) for evaluating and managing the transition of environmental technologies/systems as they progress through the OST Technology Decision Process described herein. The process identifies requirements that must be completed at the end of each stage, the organization/ individual responsible for preparing supporting documents, the organizations/individuals responsible for selecting and qualifying decisions at each gate, and the responsibilities of the review group at Gate 4.

4.2 Guidance for Preparing Requirements Documents

Specific activities are identified at each stage and gate, and documentation must be prepared to support the decision process. The FA/CC/IP are responsible for ensuring proper input and preparation of the deliverables identified and completed at each gate to reflect the current status of the technology. The requirements and deliverables that are necessary for each gate are "snapshots in time." That means that as a technology progresses through the decision process, it will be reassessed at each gate based on the responses and deliverables at that gate. For example, at Gate 1 there is a requirement for the technology to "be relevant to a defined high-priority DOE environmental management need." If the technology does not address a specific DOE-EM need, it should not pass Gate 1. The same requirement exists for Gates 1 through 5. If the technical need is overcome or addressed through other systems or approaches, the project should not continue. The continued need must be justified at each gate. Another example is the need to define and

document the "technical advantage(s) over baseline and alternative technologies." This requirement is consistent throughout the gates. If, at any gate, the technology does not have technical advantages over current baseline or alternative technologies, it should not pass through that gate.

4.3 Roles and Responsibilities

4.3.1 Focus Area/Crosscutting Programs/Industry Programs/ (includes field and headquarters representatives)

4.3.1.1 Provide leadership, guidance, and funding for EM-50 and apply this procedure to managing the transition of technologies from research through implementation.
4.3.1.2 Facilitate communication between the Site Technology Coordinating Group (STCG) (identifier of technology needs) and the technology developer/principal investigator (TD/PI) (technology solution provider) when requested.
4.3.1.3 Support the TD/PI in determining the stage/gate of the technology.
4.3.1.4 Collect and review data requirements defined herein to determine the maturation of technologies. This information will be submitted to the review group at Gate 4 for their review to ascertain the consistency of the decision-making process.
4.3.1.5 Serve as the primary interface with the review group.
4.3.1.6 Provide feedback on review group's determination to the TD/PI.
4.3.1.7 Assist the TD/PI in obtaining resources and contacts supporting accomplishment of the criteria in Attachment D.

4.3.2 Site Technology Coordinating Groups (as end-user representatives)

4.3.2.1 Survey their sites and determine technology needs.
4.3.2.2 Determine the priority of technology needs for their sites.
4.3.2.3 Determine time frames for the desired implementation of specific technologies.
4.3.2.4 Identify specific functional performance requirements.
4.3.2.5 Identify baseline technologies and costs for special environmental management needs.

4.3.3 Technology Developers/Principal Investigators

4.3.3.1 Prepare technical proposals for submittal to focus areas.
4.3.3.2 Prepare multiyear (life-cycle) technical task plans (TTPs).
4.3.3.3 Demonstrate that the technical capability and acceptability of technologies meet the need(s).
4.3.3.4 Provide plan and schedule for maturation of technologies/systems through the decision process.
4.3.3.5 Identify regulatory requirements.
4.3.3.6 Provide cost analyses information.
4.3.3.7 Provide justification/rationale for placement of a technology at a particular stage/gate.

4.3.3.8 Provide relevant information to the FA/CC/IP program for submission to the review group.

4.3.4 Office of Science and Technology Review Group

4.3.4.1 Reviews submittals from FA/CC/IP programs for evaluation of consistency with this procedure at Gate 4.
4.3.4.2 Submits findings of the review and "GO/HOLD/STOP" recommendation to the decision process coordinator.

4.3.5 Peer Review

4.3.5.1 Performs technical peer reviews of OST-funded technologies in accordance with the *Technical Peer Review Program Provisional Guidance* dated October 1996 and the *Peer Review Manual* dated January 1997.

4.3.6 Decision Process Coordinator

4.3.6.1 Maintains this procedure at the request of the Deputy Assistant Secretary (DAS).
4.3.6.2 Identifies the review group membership and coordinates its activities.
4.3.6.3 Provides training on the decision process as necessary.
4.3.6.4 Receives documentation from FA/CC/IP, performs a preliminary review to ensure data has been provided to address the required deliverables and submits these data packages to the review group.
4.3.6.5 Receives draft reports from the review group and formalizes them for distribution.
4.3.6.6 Provides feedback to FA/CC/IP, TD/PIs, and STCGs, as necessary.
4.3.6.7 Provides summaries of review group activities and recommendations as appropriate.
4.3.6.8 Establishes a system to track stage/gate progress of all technologies based on FA/CC/IP input.
4.3.6.9 Reviews project portfolios to ensure progress and recommends technology reviews to the responsible OST director for technologies that appear stagnant.
4.3.6.10 Develops and maintains lessons-learned for decision process activities.
4.3.6.11 Establishes a review schedule to accommodate EM OST requirements.

5. PROCEDURE

The OST Technology Decision Process represents a series of stages and gates, from basic research through implementation. The scope of the process emphasizes all activities from basic research through, and including, the actions required for implementation/use of a technology or a technological system that meet a defined performance requirement or that address a clearly defined set of problems. The OST Technology Decision Process Gate Requirements and Deliverables, Attachment D, provides specific informational requirements that must be addressed for a technology to pass through a gate. The intent of the process is to (1) facilitate the collection of information; (2) specify the standard format for information; and (3) facilitate sound and timely decision-making based upon three major actions: GO

forward, HOLD for specific action, or STOP do not proceed. The FA/CC/IP will use this document to perform a review of every technology as it passes through a gate. At Gate 4, the information will be submitted to the review group as defined herein. The requirements and deliverables matrix (Attachment E) outlines the requirements at each gate. Technologies developed in the private sector and brought into the DOE-EM system for consideration of research, development, or implementation must be subjected to the stage/gate criteria by the FA. Consideration for a commercial-scale demonstration to obtain performance and cost-of-performance data on a real-world environmental management problem may be appropriate.

5.1 Stage and Gate Minimum Procedure Requirements

Attachment C is a diagrammatic description of the OST Technology Decision Process. The following procedure defines the related specific minimum goals, objectives, measures of effectiveness, actions, and responsibilities associated with each stage and gate.

5.1.1 Stage 1: Basic Research

This stage represents fundamental scientific research for building and documenting core knowledge not tied to a specific, defined need. It includes basic laboratory experimentation, development of theory and analytical models, and proof of principle.

Stage Goal: Generate new ideas.
Objectives: Identify new environmental technology/use of good science.
Measures of Effectiveness: Satisfy programmatic driver criteria (technology end user need, technical merit, costs, and safety/health/environmental protection/risk).

5.1.2 Gate 1: Entrance into Applied Research Stage

Research/studies addressing environmental performance needs. TD/PI addresses programmatic driver criteria (technology end user need, technical merit, costs, and safety/health/environmental protection/risk).

5.1.3 Stage 2: Applied Research

At this stage, directed scientific/engineering research is conducted that has a link to environmental management needs. Included are proof of principle and laboratory-scale experimentation.

Stage Goal: Conduct systems studies to address DOE-EM high-priority needs.
Objectives: Define data requirements, prepare experimental designs, determine material requirements, and determine business attributes.
Measures of Effectiveness: Satisfy experimental design plan acceptance criteria and programmatic driver criteria (technology end user need, technical merit, costs, safety/health/environmental

protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.4 Gate 2: Entrance into Exploratory Development Stage

- Linked with clearly defined DOE-EM priority performance needs.
- Satisfied experimental design criteria.
- TD/PI initiates baseline comparison.
- TD/PI addresses gate programmatic driver criteria (technology end user need, technical merit, costs, safety/health/environmental protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.5 Stage 3: Exploratory Development

In this stage, technical feasibility in terms of potential applications is evaluated (i.e., can the technology be sufficiently developed to solve the problem). Included are laboratory-scale prototyping, analysis of user needs, estimates of life-cycle costs, and identification of functional performance requirements and operational concepts.

Stage Goal: Conduct system study to address FA/CC/IP and/or STCG identified priority needs.
Objectives: Verify concept linked to specific needs.
Measures of Effectiveness: Continues to satisfy experimental design plan acceptance criteria and experimental performance meets program expectations and programmatic driver criteria (technology end user need, technical merit, costs, safety/health/ environmental protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.6 Gate 3: Entrance into Advanced Development Stage

- Linked with clearly defined DOE-EM/private sector priority performance needs.
- TD/PI continues baseline comparison.
- TD/PI addresses gate programmatic driver criteria (technology end user need, technical merit, costs, safety/health/environmental protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.7 Stage 4: Advanced Development

In this stage, proof of design is required. This includes full-scale laboratory testing, preliminary field testing, technical specification development, and infrastructure development plans.

Stage Goal: Specific DOE-EM application of product, concept, or subsystems that includes studies, advanced analysis, and laboratory-scale models.

Objectives: Review group application validation, specifications assessment.
Measures of Effectiveness: Satisfy external assessment of application specifications and programmatic driver criteria (technology end user need, technology merit, costs, safety/health/environmental protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.8 Gate 4: Entrance into the Engineering Development Stage (major decision point; includes review group interaction)

- Review group completes review of information supplied by FA/CC/IP, TD/PI, and others.
- Technology assessed as being the right technology, at the right place, at the right time.
- TD/PI addresses gate programmatic driver criteria (technology end user need, technology merit, costs, safety/health/environmental protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.9 Stage 5: Engineering Development

This stage includes systematic use of the knowledge gained from research and development to develop a detailed approach for full-scale design. Components include documentation such as drawings, schematics, and computer codes; construction and demonstration units; prototypes and pilot-scale systems; system evaluation; reliability testing; infrastructure plans; and procurement specifications.

Stage Goal: Classified as a technology or system likely to exceed DOE-EM baseline or likely to meet select government performance requirements or a problem set.
Objectives: Scale-up and refine detailed design for prototypes and pilots; clarify DOE deployment strategy and schedules to meet internal/external performance needs.
Measures of Effectiveness: Completed and documented preliminary test results and satisfied test plans and programmatic driver criteria (technology end user need, technology merit, costs, safety/health/environmental protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.10 Gate 5: Entrance into the Demonstration Stage

- DOE-EM deployment schedule established.
- Completed and documented preliminary test results and satisfied test plan requirements.
- An Innovative Technology Summary Report referenced herein is issued unless a full-scale demonstration is to be performed in Stage 6.
- TD/PI addresses gate programmatic driver criteria (technology end user need, technology merit, costs, safety/health/environmental protection/risk, stakeholder/regulator/tribal, and commercial viability).

5.1.11 Stage 6: Demonstration

At this stage, the product or technology is subjected to a "real world" demonstration, either at a DOE site or at another location, using actual or simulated waste streams and/or anticipated operating conditions to verify assumptions made to this point.

Stage Goal: Verification of design through test and evaluation of full-scale system.
Objectives: System suitability, full-scale testing, system testing and market conditioning.
Measures of Effectiveness: End user accepts the technology and programmatic driver criteria (technology end user need, technology merit, costs, safety/health/environmental protection/risk, stakeholder/ regulator/tribal, and commercial viability) are met.

5.1.12 Gate 6: Entrance into the Implementation Stage

- Results of technology/system test is fully documented and a final Innovative Technology Summary Report is issued. A Cost and Performance Report for environmental remedial projects shall also be prepared at this gate for EM-40-funded technologies.
- Technology partner is fully invested (i.e., procurement path defined).
- Implementation and commercialization viability have been clearly defined according to accepted business standards.
- Gate programmatic driver criteria have been fully engaged (technology end user need, technology merit, costs, safety/health/environmental protection/risk, stakeholder/ regulator/tribal, and commercial viability).

5.1.13 Stage 7: Implementation

The product or technology has been proven to be viable, cost-effective, and applicable to required needs and is put into service by the end user. The technology must be available for transfer to the private sector or already commercially available for commercial use.

5.2 Stage and Gates Procedure Operations Management

Attachment D depicts the OST Technology Decision Process Gate Requirements and Deliverables. Attachment E is the Requirements and Deliverables Matrix.

5.2.1 Stage Procedure Operations Management Responsibilities

The FA/CC/IP—through the assigned TD/PI and others, as appropriate—is responsible for documentation of all the requirements defined in Sections 5.1.1 through 5.1.13 and as outlined further in Attachment D. The FA/CC/IP in concert with the TD/PI will plan, arrange, and carry out activities and responsibilities according to the stage conditions/requirements for purposes of presenting, justifying, and meeting each of the gate criteria.

5.2.2 Gate Procedure Operations Management Responsibilities

The FA/CC/IP is responsible for evaluating the documentation at all gates in accordance with the listed gate criteria. If the FA/CC/IP program determines the technology warrants passing through the gate, the TD/PI, the site DOE management, and others, as appropriate, will be notified and the technology maturation process will continue. If the evaluation indicates the technology does not warrant further consideration, the TD/PI, the site DOE management, and others, as appropriate, will be notified that further support from the FA/CC/IP will not be forthcoming. If the evaluation reflects uncertainties about the technology, the FA/CC/IP may HOLD for reconsideration. As a check for consistency of the decision process across the OST organization, at Gate 4 the FA/CC/IP will submit the documentation requirements to the Decision Process Coordinator for consideration by the review group. The review group will then make GO, HOLD, or STOP recommendations to the FA/CC/IP and OST management.

5.3 Gate Procedure and Peer Review

An OST peer review system discussed in the *Technical Peer Review Program Provisional Guidance* has been established and will be used to facilitate assessment of the technology. The peer review information, however, will be shared with OST management and the OST Technology Decision Process review group. OST has determined that a peer review must be conducted before a technology passes through Gate 4. The FA/CC/IP and the peer review group are responsible for peer review activity in accordance with the guidance document referenced previously. The peer review group does not address all the criteria in this document. It focuses on the technical merit of the technology.

5.4 Office of Science and Technology Review Group

The OST Review Group members are identified by the Decision Process Coordinator and are to ensure that new and/or innovative technologies are assessed and managed in a consistent manner in accordance with criteria listed herein. This group will convene to review all technologies that the FA/CC/IP submit for passage through Gate 4 and at other times as requested by the FA/CC/IP.

The size of the review group shall be appropriate for the number of technologies to be evaluated. The minimum number of members shall be three. Minimum criteria for membership on the review group is as follows: (1) must be a federal employee, (2) must be knowledgeable of the EM Program, (3) must be available within the required time frame of the review, and (4) must have the appropriate technical background and experience, and (5) must be independent from the site that is being reviewed.

6. RECORDS

All documentation generated as a result of this procedure shall be collected and maintained in accordance with applicable document control and preservation requirements. The FA/CC/IP will maintain records of the application of this procedure as technologies pass through the gates.

7. ATTACHMENTS

- Attachment A, References.
- Attachment B, Definitions.
- Attachment C, OST Technology Decision Process Chart.
- Attachment D, OST Technology Decision Process Gate Requirements and Deliverables.
- Attachment E, Requirements and Deliverables Matrix.

8. REVISION LISTING

Revision number	Description	Date approved
0	New procedure	

ATTACHMENT A
REFERENCES

Amendment to the Memorandum of Understanding for the Evaluation and Promotion of Environmental Technologies dated June 4, 1996.

Cal/EPA "Close-up: Progress in Motion, California's Environmental Technology Certification Program," Vol. 5/No. 12.

DOE Office of Environmental Restoration and Waste Management Standard Operating Procedures No. EM-50-2.1.1, "Preparing Program Baselines," Revision No. 0, April 20, 1995.

DOE Office of Environmental Restoration and Waste Management Standard Operating Procedures No. EM-50-2.1.5, "Prioritizing Work," Revision No. 0, April 20, 1995.

DOE Office of Environmental Restoration and Waste Management Standard Operating Procedure No. EM-50-2.1.6, "Preparing Technical Task Plans," Revision No. 0, April 20, 1995.

DOE Order 4700.1 *DOE Program Management System*, March 6, 1987, Change No. 1, June 2, 1992.

Federal Remediation Technologies Round Table, *Guide to Documenting Cost and Performance for Remediation Projects*, EPA-542-B-95-002, March 1995.

Global Environmental Technology Enterprise, The DOE/EM Commercialization Process, February 2, 1995.

Heeb, Michael and Amibal Taboas, *Technical Peer Review Program Provisional Guidance*, October 1996.

Longsworth, Paul L. and Joseph B. Paladino, *A Decision Model for Technology Development in the Department of Energy's Environmental Clean-up Program*, July 1995.

Los Alamos National Laboratory, "Cost Savings Deliverables and Criteria for the OST Technology Decision Process," (Draft), Revision 1.2, April 25, 1997.

Paladino, Joseph B., and Brian Fox, "A Framework for R&D Planning in EM" (Draft), April 8, 1995.

"Peer Review Manual," January 1997.

"Preparation Guidance for the Office of Science and Technology's Innovative Technology Summary Reports," (Draft), April 1997.

U.S. Department of Energy, Office of Environmental Management, *Documenting Cost and Performance for Environmental Remediation Projects*, May 3, 1996.

ATTACHMENT B
DEFINITIONS

Advanced development—Advanced development refers to the technology development stage following exploratory development. Advanced development focuses the technology to a specific application. Work performed during this stage results in product specifications, more detailed performance requirements, proof of practice, and sufficient detail to provide a basis for cost-benefit analysis.

Applied research—Applied research, when used herein, refers to the stage that is a continuation of basic research, with the distinction that knowledge gained from the basic research stage is applied to problems related to potential customers' needs and practical application of the knowledge is identified.

Available for transfer—At any time during the development and commercialization process a technology can be considered available for transfer if the ownership issues have been resolved among all of the intellectual property holders and the owners are willing to transfer the rights under specific terms. This does not equate to a measure of the readiness of the technology or to its advantages relative to competing technologies.

Baseline technology—Baseline technology refers to a technology component or system against which related alternative technologies are compared.

Basic research—Basic research refers to the technology development stage during which fundamental research is undertaken to build core scientific or engineering knowledge; no specific need, end user, or application of this knowledge is necessarily identified at this stage.

Bench scale—Bench scale implies "bench-scale testing" using the definition of "bench-scale testing" from *McGraw-Hill Dictionary of Scientific and Technical Terms*: "testing of materials, methods, or chemical processes on a small scale, such as a laboratory worktable."

Commercially available—When rights to a technology are held by a private company and a credible product, process, or related services can be procured and used immediately, the technology shall be considered commercially available.

Commercial partner—A commercial partner is a private sector participant who shares the cost and risk associated with the development of a technology.

Commercial-scale demonstration—A test of a commercial (engineering and/or production) prototype of a technology-based product or a commercial unit to obtain performance and cost-of-performance data on a real world environmental or waste management problem for the technology developer, potential customers, regulators, and other stakeholders. The test results should be sufficient to determine the usefulness of the technology for a specific application. Demonstrations may occur

- when data are collected that define performance and cost-of-performance across the range of application-specific operating conditions for which the technology or system is designed or, less frequently, that define site-specific or waste-stream-specific performance and cost-of-performance data or

- whether or not a site-specific or waste-stream-specific problem is solved in part or in its entirety.

Commercial use—This has two sequential steps, each necessary and separate. The first is procurement from a commercial vendor for implementation, followed by actual application/implementation to effect environmental or waste management and/or, even, for a nonenvironmental purpose. Use (as opposed to "commercial use") may occur whether or not a technology is commercially available.

Commercialization—Commercialization is the process by which technologies that are conceived within the DOE laboratory system are transferred to the private sector for commercial or DOE applications.

Customer—A customer is an individual or organization who provides the funding for a set of activities or projects with an expected outcome or product.

Demonstration—Demonstration normally has the dictionary definition: "1. The act of making evident or proving. 2. Conclusive evidence; proof. 3. An illustration or explanation as of a theory or product, by exemplification or practical application." When used to mean a method of verification, demonstration is an exhibition of the operability or support ability of an item under intended service-use conditions. These verifications are usually nonrepetitive and are oriented almost exclusively toward acquisition of qualitative data. Demonstrations may be accomplished by computer simulation.

EM-30—The DOE-EM Office of Waste Management organization.

EM-40—The DOE-EM Office of Environmental Restoration organization.

EM-50—The DOE-EM Office of Science and Technology organization.

EM-70—The DOE-EM Office of Site Operations organization.

End user—End users are organizations responsible for environmental restoration or treatment of mixed waste. To the extent that the waste generator is responsible for treatment, storage, and disposal (TSD), the generator may also be an end user. Most end users will be from within DOE. Potential end users include companies or industrial organizations who propose to establish waste facilities.

Engineering development—Engineering development refers to the technology development stage following advanced development. During engineering development, prototype equipment is built to test design features and performance limits. Either bench-scale or pilot-plant systems may be built and tested during the engineering development stage. Research Conservation and Recovery Act treatability studies are included within engineering development independent of the physical scale of the equipment used. Work performed during this stage results in a technology (but not necessarily an operating system) that is ready for an end user. Results from the development and testing should provide performance and cost data to support conceptual design and/or capital funding for full-scale production system. Funding for engineering development is shared between EM-50 and an end user.

Focus Areas—Technology development for specific cleanup functions or applications. The four established Focus Areas are Subsurface Contaminants, Decontamination and Decommissioning, Mixed Waste, and Waste Tanks.

Implementation—Actual application or use to effect environmental or waste management and/or, even, for a nonenvironmental purpose. Implementation in the EM context means that the technology or system was used ("implemented") or was selected for use ("selected or implementation") to meet specified user performance measures (i.e., assessment complete, remediation action complete, interim action complete, waste treated for disposal, or decommissioning and decontamination complete). Implementation usually does not occur outside of commercial availability and/or procurement.

Intellectual Property—Means patents, patent applications, protected Cooperative Research and Development Agreements (CRADA) information, trademarks, copyrights, mask works, and other forms of comparable property rights protected by federal law.

Peer Review—A quality control process conducted by noncompromised experts of national repute to assure that the technology is state-of-the-art and based on high-quality, reproducible data.

Pilot plant—"A pilot plant, a small version of a planned industrial plant, is built to gain experience in operating the final plant." The definition is obtained from the *McGraw-Hill Dictionary of Scientific and Technical Terms*. Note that the term "small" is not defined and is therefore negotiable; however, it is generally accepted that the pilot plant will perform (all/most) of the key functions of the final facility.

Private Sector Partner— A nongovernmental organization that financially and technically supports the commercialization of EM-50 funded technologies.

Project manager—A project manager is the person responsible for the programmatic direction, cost, and schedule of a block of work. A project manager may or may not be a principal investigator (PI).

Principal investigator—A PI is a senior member of a development or demonstration team who is responsible for the technical progress and direction of a task being conducted by the team.

Prototype—"A model suitable for use in complete evaluation of form, design, and performance" (from the *McGraw-Hill Dictionary of Scientific and Technical Terms*). In this definition, the term "complete evaluation" refers to the applicable Technology Development Requirements document. Consequently, the term prototype can refer to equipment, processes, or systems of any size, complexity, or stage of development.

Public record—The public record contains all the documentation that should be available to the public. This information may be used as evidence in any court action. The public record includes, but is not limited to, letter reports, documentation of stakeholder/regulatory activities, meeting minutes and minutes of public hearings, brochures, videotapes, technical papers, news releases, fact sheets, articles, test report needs and requirements documents, technology performance reports, test plans, technology development plans, marketing strategies, and public involvement plans.

Regulators—Federal, state, and local organizations responsible for the application and utilization of technologies within legally established parameters.

Review group—The review group is responsible for evaluating the documentation submitted by the FA/CC/IP to ensure decisions regarding the progress of technologies through the gate process are made in a consistent manner.

STCG—Site Technology Coordinating Group is an organization with representation from site technology users, technology providers, and other interested groups and individuals that are responsible for identifying technology needs and/or gaps.

Stakeholders—Stakeholders are all those who have an interest in the outcome of the program. Members of DOE and DOE contractors who have a direct and immediate interest or involvement are not considered stakeholders.

Technical contact—A technical contact is an individual with an academic background that includes, as a minimum, a formal academic degree in engineering (such as chemical, mechanical, electrical), environmental science, chemistry, physics, or geology, or equivalent experience.

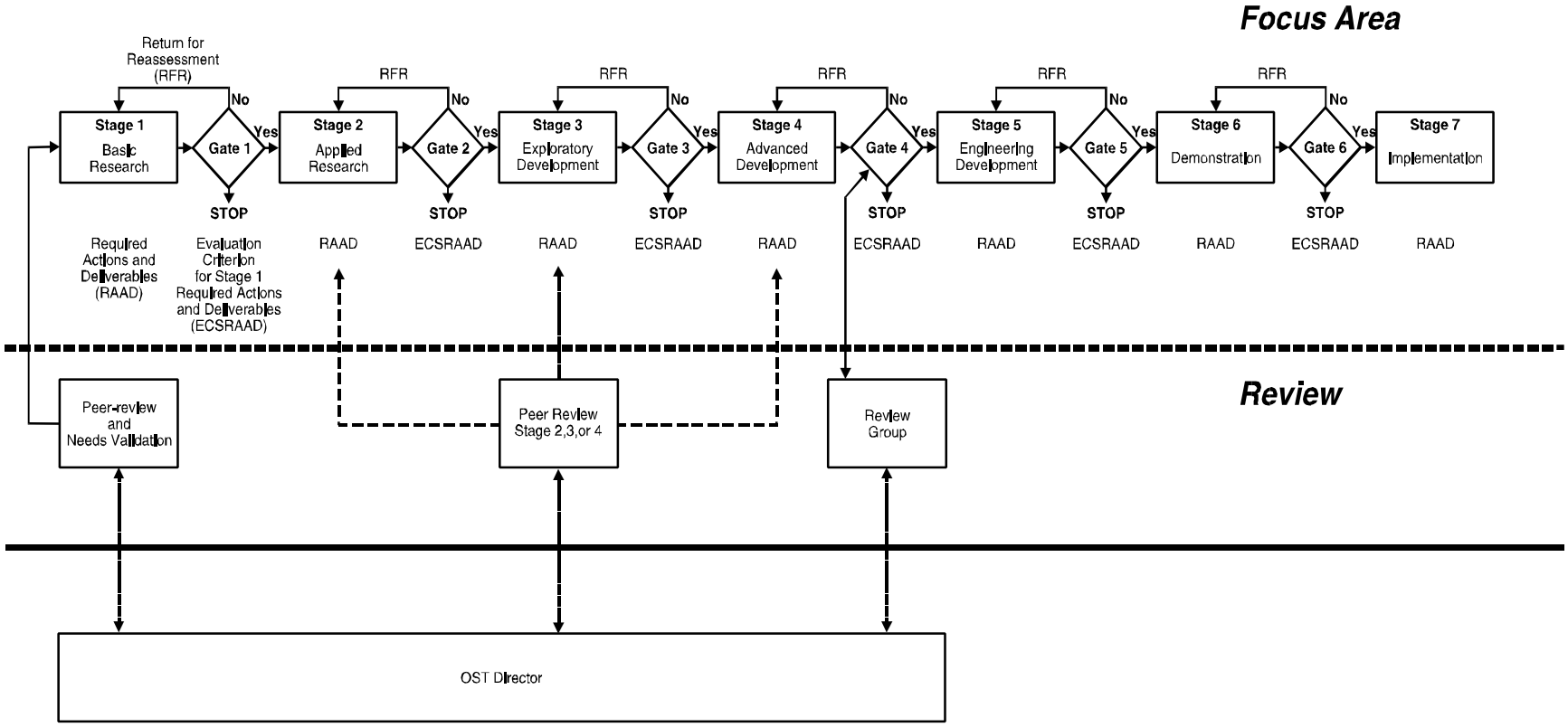
Technical task plan—A technical task plan is the budget and planning document used to submit a proposal, request funding, justify support, and describe the tasks to be performed. It is a multipart document that serves as a budget request and technical execution plan. Technical task plans consist of three parts: Part 1, a summary form containing information for input into the program's statistical data base; Part 2, the task justification; and Part 3, the project execution plan.

Technology developer—The individual or organization that develops a particular technology.

Tribal Governments—Formal governing organizations of the American Indians.

ATTACHMENT C

OST-Technology Decision Process Chart



ATTACHMENT D
DEPARTMENT OF ENERGY (DOE) OFFICE OF SCIENCE AND TECHNOLOGY (OST)
TECHNOLOGY DECISION PROCESS
GATE REQUIREMENTS AND DELIVERABLES

Gate 1—Entrance into Applied Research Stage

The documentation/deliverables for Gate 1 must address the following criteria/requirements. This documentation should include formal reports and plans where applicable and must be identified such that they correspond to the appropriate deliverable. The technical activities' specific contribution(s) to the 10-Year Plan should be identified. The level of detail provided in the deliverables identified below should be sufficient to ensure the requirements reflect the status of the technology as it enters this gate.

1. Programmatic Driver Criterion: Technology End User Need

    1.1 Requirement: Project must be relevant to a defined high-priority DOE environmental management need.
        1.1.1 Deliverable: The TD/PI must show how the proposed technology is tied directly to one or more of these needs.
        1.1.2 Background: The FA/CC/IP Programs will develop a high-priority EM needs list for their respective program from the information gathered on the needs template established by the STCGs. This will include the priority of the need, required implementation dates, baseline technology, performance requirements, and associated costs.

    1.2 Requirement: Research will yield results within a time frame consistent with implementation/deployment needs.
        1.2.1 Deliverable: The TD/PI must provide evidence that the research and development of the technology has a high probability of completion within the required implementation/deployment time frame.
        1.2.2 Background: The required implementation dates for the technology will be provided by the FA/CC/IP.

2. Programmatic Driver Criterion: Technical Merit

    2.1 Requirement: Scientific and/or technical merit of the project must be well founded.
        2.1.1 Deliverable: The TD/PI must provide evidence that the research is based on sound scientific principles.

    2.2 Requirement: Likelihood is high that the research will lead to new discoveries or have substantial impact on progress in that field.
        2.2.1 Deliverable: The TD/PI should emphasize the innovative aspects of the technology.

    2.3 Requirement: Proposed methods or approach for demonstration and implementation are scientifically based.
        2.3.1 Deliverable: The TD/PI must discuss the appropriateness of the research as it relates to acceptable technical practices.

2.4 Requirement: Potential technical advantage(s) over baseline and/or alternative technologies must be well defined.

2.4.1 Deliverable: The TD/PI must provide evidence that the technology has technical advantages over the baseline and/or alternative technologies.

2.4.2 Background: The baseline technology will be provided by the FA/CC/IP in concert with the STCG and site.

3. Programmatic Driver Criterion: Cost

3.1 Requirement: The proposed budget for research is reasonable.

3.1.1 Deliverable: The TD/PI must show the budget for the life of the project broken down on an annual basis. An estimated budget with major elements identified and costed for the research through Stage 3 must be provided.

4. Programmatic Driver Criterion: Safety, Health, Environmental Protection, and Risk

4.1 Requirement: The research must present a solution that meets or exceeds current safety, health, and environmental protection levels and meets or reduces the risk to the public, workers, and the environment during operation in comparison to baseline and alternative technologies.

4.1.1 Deliverables: The TD/PI must discuss how the research to-date has demonstrated the likelihood that safety, health, and environmental protection levels will be maintained or exceeded and that risk to the public, workers, and the environment will be maintained or reduced.

4.1.2 Background: The baseline technology will be provided by FA/CC/IP in concert with the STCG and site.

5. Programmatic Driver Criterion: Stakeholder, Regulatory, and Tribal Issues

Not applicable at this gate.

6. Programmatic Driver Criterion: Commercial Viability

Not applicable at this gate.

Gate 2—Entrance into Exploratory Development Stage

The documentation/deliverables for Gate 2 must address the following criteria/requirements. **(New requirements for this Gate are identified in bold letters.)** This documentation should include formal reports (i.e., technical peer reviews) and plans, where applicable, and must be identified such that they correspond to the appropriate deliverable. The technical activities' specific contribution to the 10-Year Plan should be identified. The level of detail provided in the deliverables identified below should be sufficient to ensure that the requirements reflect the status of the technology as it enters this gate.

1. Programmatic Driver Criterion: Technology End User Need

    1.1 Requirement: Project must be relevant to a defined high-priority DOE environmental management need.
        1.1.1 Deliverable: The TD/PI must show how the proposed technology is tied directly to one or more of these needs.
        1.1.2 Background: The FA/CC/IP Programs will develop a high-priority EM needs list for their respective program from the information gathered on the needs template established by the STCGs. This will include the priority of the need, required implementation dates, baseline technology, performance requirements and associated costs.

    1.2 Requirement: Research will yield results within a time frame consistent with implementation/deployment needs.
        1.2.1 Deliverable: The TD/PI must provide evidence that the research and development of the technology has a high probability of completion within the required implementation/deployment time frame.
        1.2.2 Background: The required implementation dates for the technology will be provided by the FA/CC/IP.

    1.3 Requirement: Research has been linked to specific end-user needs.
        1.3.1 Deliverable*:* The results of the research to-date must show a direct tie to end user needs. Results should be documented in papers and/or formal reports. Where possible, the technology should show how it fills a gap in availability of needed technology or identify and quantify a potential benefit.
        1.3.2 Background: Specific end user needs are identified and provided by the FA/CC/IP with input from the STCG and site.

2. Programmatic Driver Criterion: Technical Merit

    2.1 Requirement: The scientific and/or technical merit of the project must be well founded.
        2.1.1 Deliverable: The description of the technology/process, major elements, and support equipment/systems must be discussed in sufficient detail to determine the scientific principles underlying the technology and the technical merits of the project are well founded.

2.2 Requirement: The likelihood is high that the research will lead to new discoveries or have substantial impact on progress in that field.

2.2.1 Deliverable: The TD/PI should emphasize the innovative aspects of the technology and how it would impact the methods currently used in the field.

2.3 Requirement: Proposed methods or approach for demonstration and implementation are scientifically based.

2.3.1 Deliverable: The TD/PI must discuss the scientific bases for moving the technology from proof-of-principal and laboratory-scale experimentation to laboratory-scale prototyping.

2.4 Requirement: Potential technical advantage(s) over baseline and alternative technologies are defined and documented.

2.4.1 Deliverable: The TD/PI must provide evidence that the technology has technical advantages over the baseline technologies.

2.4.2 Background: The baseline technology will be provided by the FA/CC/IP in concert with the STCG and site.

2.5 Requirement: Evidence must be provided that technical feasibility has been demonstrated and that it will meet performance requirements. This evidence should include summaries of proof-of-principal and/or laboratory-scale experimentation.

2.5.1 Deliverable: The results to-date from proof-of-principal and laboratory-scale experimentation should provide evidence that the technology will meet the requirement of the end user. Clear and direct scale-up capability for future prototype and full-scale demonstrations and implementation must be provided**.**

2.5.2 Background: The end user performance requirements will be provided by the FA/CC/IP in concert with the STCG and site**.**

3. Programmatic Driver Criterion: Cost

3.1 Requirement: Proposed budget for the research is reasonable and appropriate.

3.1.1 Deliverable: The TD/PI must provide an estimated budget for the life of the project on an annual basis. Funding expectations from all major organization (private sector, DOE, and other governmental organizations) and funding contributions for labor, services, materials, and process equipment must be provided.

3.2 Requirement: Preliminary cost estimates reflecting advantages over the cost of baseline and alternative technologies must be provided.

3.2.1 Deliverable: The TD/PI must discuss the methodology and basic assumptions used in comparing the technology with the baseline and/or alternative technologies.

3.2.2 Background: Baseline cost information will be provided to the TD/PI by the FA/CC/IP with input from the STCGs and sites. In developing cost analysis information, please refer to the **"**Cost Savings Deliverables and Criteria for the OST Technology Decision Process" listed as a Reference Document in Attachment A of this procedure.

4. Programmatic Driver Criterion: Safety, Health, Environmental Protection, and Risk

4.1 Requirement: The research must present a solution that meets or exceeds current safety, health, and environmental protection levels and meets or reduces the risk to the public, workers, and the environment during operation in comparison to baseline and alternative technologies.

4.1.1 Deliverables: The TD/PI must discuss how the research to-date has demonstrated the likelihood that safety, health, and environmental protection levels will be maintained or exceeded that risk to the public, workers, and the environment will be maintained or reduced.

4.1.2 Background: The baseline technology will be provided by FA/CC/IP in concert with the STCG and site.

5. Programmatic Driver Criterion: Stakeholder, Regulator and Tribal Issues

5.1 Requirement: Stakeholder, regulator and tribal issues associated with similar technologies have been identified and assessed.

5.1.1 Deliverable: The TD/PI must provide evidence that each of the issues associated with similar technologies under this driver criterion have been identified and assessed.

5.1.2 Background: The FA/CC/IP with support from the STCGs and the sites will provide input for these issues.

5.2 Requirement: Appropriate notification and permitting requirements must be identified.

5.2.1 Deliverable: The TD/PI must provide evidence that notification and permitting requirements for utilization of the technology have been identified.

6. Programmatic Driver Criterion: Commercial Viability

6.1 Requirement: A preliminary product concept has been defined.

6.1.1 Deliverable: The TD/PI must provide a discussion of the preliminary product concept.

6.2 Requirement: Invention disclosure and intellectual property issues have been identified and protected as appropriate.

6.2.1 Deliverable: The TD/PI must provide evidence that invention disclosures and intellectual property issues have been identified and protected as appropriate.

Gate 3—Entrance into Advanced Development Stage

The documentation/deliverables for Gate 3 must address the following criteria/requirements. **(New requirements for this Gate are identified in bold letters.)** This documentation should include formal reports (i.e., technical peer reviews), and plans, where applicable, and must be identified such that they correspond to the appropriate deliverable. The technical activities' specific contribution to the 10-Year Plan should be identified. The level of detail provided in the deliverables identified in the following should be sufficient to ensure that the requirements reflect the status of the technology as it enters this gate.

1. Programmatic Driver Criterion: Technology End User Need

    1.1 Requirement: Project must be relevant to a defined high-priority DOE environmental management need.
        1.1.1 Deliverable: The TD/PI must show how the proposed technology is tied directly to one or more of these needs.
        1.1.2 Background: The FA/CC/IP Programs will develop a high-priority EM needs list for their respective program from the information gathered on the needs template established by the STCGs. This will include the priority of the need, required implementation dates, baseline technology, performance requirements, and associated costs.

    1.2 Requirement: Research will yield results within a time frame consistent with implementation/deployment needs.
        1.2.1 Deliverable: The TD/PI must provide evidence that the research and development of the technology has a high probability of completion within the required implementation/deployment time frame.
        1.2.2 Background: The required implementation dates for the technology will be provided by the FA/CC/IP.

    1.3 Requirement: Research has been linked to specific end user needs.
        1.3.1 Deliverable*:* The results of the research to-date must show a direct tie to end user needs. Results should be documented in papers and/or formal reports. Where possible, the technology should show how it fills a gap in availability of needed technology or identify and quantify a potential benefit.
        1.3.2 Background: Specific end user needs are identified and provided by the FA/CC/IP with input from the STCG and site.

    1.4 Requirement: End user performance requirements have been incorporated into the project and implementation issues have been defined.
        1.4.1 Deliverable*:* The TD/PI must provide evidence that the end user performance requirements have been addressed in the research and development activities to-date and how they will be met when implemented in the field.
        1.4.2 Background: The end user performance requirements will be provided by the FA/CC/IP as supplied by the STCG.

2. Programmatic Driver Criterion: Technical Merit

2.1 Requirement: The scientific and/or technical merit of the project must be well founded.
2.1.1 Deliverable: The description of the technology/process, major elements, and support equipment/systems must be discussed in sufficient detail to determine the scientific principles underlying the technology and the technical merits of the project are well founded.

2.2 Requirement: The likelihood is high that the research will lead to new discoveries or have substantial impact on progress in that field.
2.2.1 Deliverable: The TD/PI should emphasize the innovative aspects of the technology and how it would impact the methods currently used in the field.

2.3 Requirement: Proposed methods or approach for demonstration and implementation are scientifically based.
2.3.1 Deliverable: The TD/PI must discuss the scientific bases for moving the technology from proof-of-principal and laboratory-scale experimentation to laboratory-scale prototyping.

2.4 Requirement: Potential technical advantage(s) over baseline and alternative technologies are defined and documented.
2.4.1 Deliverable: The TD/PI must provide evidence that the technology has technical advantages over the baseline technologies.
2.4.2 Background: The baseline technology will be provided by the FA/CC/IP in concert with the STCG and site.

2.5 Requirement: Evidence must be provided that technical feasibility has been demonstrated and that it will meet performance requirements. This evidence should include summaries of proof-of-principal and/or laboratory-scale experimentation.
2.5.1 Deliverable: The results to date from proof-of-principal and laboratory-scale experimentation should provide evidence that the technology will meet the requirement of the end user. Clear and direct scale-up capability for future prototype and full-scale demonstrations and implementation must be provided**.**
2.5.2 Background: The end user performance requirements will be provided by the FA/CC/IP in concert with the STCG and site**.**

3. Programmatic Driver Criterion: Cost

3.1 Requirement: Proposed budget for the research is reasonable and appropriate.
3.1.1 Deliverable: The TD/PI must provide an estimated budget for the life of the project on an annual basis. Funding expectations from all major organization (private sector, DOE, and other governmental organizations) and funding contributions for labor, services, materials, and process equipment must be provided.

3.2 Requirement: Preliminary cost estimates reflecting advantages over the cost of baseline and alternative technologies must be provided.
3.2.1 Deliverable: The TD/PI must discuss the methodology and basic assumptions used in comparing the technology with the baseline and/or alternative technologies.

3.2.2 Background: Baseline cost information will be provided to the TD/PI by the FA/CC/IP with input from the STCGs and sites. In developing cost analysis information, please refer to the **"**Cost Savings Deliverables and Criteria for the OST Technology Decision Process" listed as a reference document in Attachment A of this procedure.

3.3 Requirement: There must be a cost benefit associated with continued investment in the research and development of this technology.

3.3.1 Deliverable: The TD/PI must provide evidence of cost savings/cost avoidance and/or return on investment through use of this technology. For return-on-investment calculations, the discount rates established in Appendix C of OMB Circular No. A-94, which is up-dated annually, may be used.

4. Programmatic Driver Criterion: Safety, Health, Environmental Protection, and Risk

4.1 Requirement: The research must present a solution that meets or exceeds current safety, health, and environmental protection levels and meets or reduces the risk to the public, workers, and the environment during operation in comparison to baseline and alternative technologies.

4.1.1 Deliverables: The TD/PI must discuss how the research to date has demonstrated the likelihood that safety, health, and environmental protection levels will be maintained or exceeded and risk to the public, workers, and the environment will be maintained or reduced.

4.1.2 Background: The baseline technology will be provided by FA/CC/IP in concert with the STCG and site.

4.2 Requirement: Safety, health, and environmental protection issues have been defined and are incorporated into the research and development documents and activities.

4.2.1 Deliverable: The TD/PI must provide evidence that these issues have been included in documentation and activities relevant to continuation of the research and development.

5. Programmatic Driver Criterion: Stakeholder, Regulator, and Tribal Issues

5.1 Requirement: Stakeholder, regulator, and tribal issues associated with similar technologies have been identified and assessed.

5.1.1 Deliverable: The TD/PI must provide evidence that each of the issues associated with similar technologies under this driver criterion have been identified and assessed.

5.1.2 Background: The FA/CC/IP, with support from the STCGs and the sites, will provide input for these issues.

5.2 Requirement: Appropriate notification and permitting requirements must be identified.

5.2.1 Deliverable: The TD/PI must provide evidence that notification and permitting requirements for using the technology have been identified.

5.3 Requirement: Stakeholder, regulator, and tribal issues for this technology have been identified.

5.3.1 Deliverable: The TD/PI must provide evidence that stakeholder, regulator, and tribal compliance issues relative to this technology have been identified.

6. Programmatic Driver Criterion: Commercial Viability

6.1 Requirement: A preliminary product concept has been defined.

6.1.1 Deliverable: The TD/PI must provide a discussion of the preliminary product concept.

6.2 Requirement: Invention disclosure and intellectual property issues have been identified and protected as appropriate.

6.2.1 Deliverable: The TD/PI must provide evidence that invention disclosures and intellectual property issues have been identified and protected as appropriate.

6.3 Requirement: A preliminary commercialization plan for government and commercial use of this technology must be completed. (Reference the DOE-EM Commercialization Process, dated February 2, 1995, prepared by the Global Environmental Technology Enterprise)

6.3.1 Deliverable: The TD/PI must provide evidence of this plan. The plan should include a market assessment.

Gate 4—Entrance into Engineering Development Stage

The documentation/deliverables for Gate 4 must address the following criteria/requirements. **(New requirements for this Gate are identified in bold letters.)** This documentation should include formal reports (i.e., technical peer reviews) and plans, where applicable, and must be identified such that they correspond to the appropriate variable. (NOTE: OST has determined that a technical peer review must be performed before a technology passes through Gate 4.) The technical activities specific contribution to the 10-Year Plan should be identified. The level of detail provided in the deliverables identified below should be sufficient to ensure the requirements reflect the status of the technology as it enters this gate.

1. Programmatic Driver Criterion: Technology End User Need

    1.1 Requirement: Project must be relevant to a defined high-priority DOE environmental management need.
        1.1.1 Deliverable: The TD/PI must show how the proposed technology is tied directly to one or more of these needs.
        1.1.2 Background: The FA/CC/IP Programs will develop a high-priority EM needs list for their respective program from the information gathered on the needs template established by the STCGs. This will include the priority of the need, required implementation dates, baseline technology, performance requirements, and associated costs.

    1.2 Requirement: Research will yield results within a time frame consistent with implementation/deployment needs.
        1.2.1 Deliverable: The TD/PI must provide evidence that the research and development of the technology has a high probability of completion within the required implementation/deployment time frame.
        1.2.2 Background: The required implementation dates for the technology will be provided by the FA/CC/IP.

    1.3 Requirement: Research has been linked to specific end user needs.
        1.3.1 Deliverable*:* The results of the research to-date must show a direct tie to end user needs. Results should be documented in papers and/or formal reports. Where possible, the technology should show how it fills a gap in availability of needed technology or identify and quantify a potential benefit.
        1.3.2 Background: Specific end user needs are identified and provided by the FA/CC/IP with input from the STCG and site.

    1.4 Requirement: End user performance requirements have been incorporated into the project and implementation issues defined.
        1.4.1 Deliverable*:* The TD/PI must provide evidence that the end user performance requirements have been addressed in the research and development activities to date and how they will be met when implemented in the field.
        1.4.2 Background: The end user performance requirements will be provided by the FA/CC/IP as supplied by the STCG.

2. Programmatic Driver Criterion: Technical Merit

    2.1 Requirement: The scientific and/or technical merit of the project must be well founded.

2.1.1 Deliverable: The description of the technology/process, major elements, and support equipment/systems must be discussed in sufficient detail to determine the scientific principles underlying the technology and the technical merits of the project are well founded.

2.2 Requirement: The likelihood is high that the research will lead to new discoveries or have substantial impact on progress in that field.

2.2.1 Deliverable: The TD/PI should emphasize the innovative aspects of the technology and how it would impact the methods currently used in the field.

2.3 Requirement: Proposed methods or approach for demonstration and implementation are scientifically based.

2.3.1 Deliverable: The TD/PI must discuss the scientific bases for moving the technology from proof-of-principal and laboratory-scale experimentation to laboratory-scale prototyping.

2.4 Requirement: Potential technical advantage(s) over baseline and alternative technologies are defined and documented.

2.4.1 Deliverable: The TD/PI must provide evidence that the technology has technical advantages over the baseline technologies.

2.4.2 Background: The baseline technology will be provided by the FA/CC/IP in concert with the STCG and site.

2.5 Requirement: Evidence must be provided that technical feasibility has been demonstrated and that it will meet performance requirements. This evidence should include summaries of proof-of-principal and/or laboratory-scale experimentation.

2.5.1 Deliverable: The results to date from proof-of-principal and laboratory-scale experimentation should provide evidence that the technology will meet the requirements of the end user. Clear and direct scale-up capability for future prototype and full-scale demonstrations and implementation must be provided.

2.5.2 Background: The end user performance requirements will be provided by the FA/CC/IP in concert with the STCG and site.

2.6 Requirement: Proof of the design of the technology application is required.

2.6.1 Deliverable: The TD/IP must provide evidence that the design of the technology for application has been completed. Evidence may include full-scale laboratory testing results, preliminary field testing results, technical specifications, and infrastructure development plans.

3. Programmatic Driver Criterion: Cost

3.1 Requirement: Proposed budget for the research is reasonable and appropriate.

3.1.1 Deliverable: The TD/PI must provide an estimated budget for the life of the project on an annual basis. Funding expectations from all major organization (private sector, DOE, and other governmental organizations) and funding contributions for labor, services, materials, and process equipment must be provided.

3.2 Requirement: Preliminary cost estimates reflecting advantages over the cost of baseline and alternative technologies must be provided.

3.2.1 Deliverable: The TD/PI must discuss the methodology and basic assumptions used in comparing the technology with the baseline and/or alternative technologies.

3.2.2 Background: Baseline cost information will be provided to the TD/PI by the FA/CC/IP with input from the STCGs and sites. In developing cost analysis information, please refer to the **"**Cost Savings Deliverables and Criteria for the OST Technology Decision Process" listed as a reference document in Attachment A of this procedure.

3.3 Requirement: There must be a cost benefit associated with continued investment in the research and development of this technology.

3.3.1 Deliverable: The TD/PI must provide evidence of cost savings/cost avoidance and return on investment through use of this technology. For return on investment calculations, the discount rates established in Appendix C of OMB Circular No. A-94, which is up-dated annually, may be used.

3.4 Requirement: Life-cycle cost estimates reflecting the advantages of this technology over the baseline and other emerging technologies must be provided.

3.4.1 Deliverable: The TD/PI and the FA/CC/IP must provide a life-cycle cost study that reflects advantages of this technology over the baseline and other emerging technologies.

4. Programmatic Driver Criterion: Safety, Health, Environmental Protection, and Risk

4.1 Requirement: The research must present a solution that meets or exceeds current safety, health, and environmental protection levels and meets or reduces the risk to the public, workers, and the environment during operation in comparison to baseline and alternative technologies.

4.1.1 Deliverables: The TD/PI must discuss how the research to date has demonstrated the likelihood that safety, health, and environmental protection levels will be maintained or exceeded and that risk to the public, workers, and the environment will be maintained or reduced.

4.1.2 Background: The baseline technology will be provided by FA/CC/IP in concert with the STCG and site.

4.2 Requirement: Safety, health, and environmental protection issues have been defined and are incorporated into the research and development documents and activities.

4.2.1 Deliverable: The TD/PI must provide evidence that these issues have been included in documentation and activities relevant to continuation of the research and development.

4.3 Requirement: Failure scenarios must be defined and contingency plans developed.

4.3.1 Deliverables: The TD/PI must provide evidence that failure scenarios for research, development, demonstration, and implementation have been defined and contingency plans developed to address these scenarios.

5. Programmatic Driver Criterion: Stakeholder, Regulator, and Tribal Issues

5.1 Requirement: Stakeholder, regulator, and tribal issues associated with similar technologies have been identified and assessed.

5.1.1 Deliverable: The TD/PI must provide evidence that each of the issues associated with similar technologies under this driver criterion have been identified and assessed.

5.1.2 Background: The FA/CC/IP with support from the STCGs and the sites will provide input for these issues.

5.2 Requirement: Appropriate notification and permitting requirements must be identified.

5.2.1 Deliverable: The TD/PI must provide evidence that notification and permitting requirements for using the technology have been identified.

5.3 Requirement: Stakeholder, regulator, and tribal issues for this technology have been identified.

5.3.1 Deliverable: The TD/PI must provide evidence that stakeholder, regulator, and tribal compliance issues relative to this technology have been identified.

5.4 Requirement: Strategies for resolving stakeholder, regulatory, and tribal issues and permit requirements must be completed.

5.4.1 Deliverable: The TD/PI, in concert with the FA/CC/IP, STCG and the site, must provide evidence that stakeholder, regulatory, and tribal issues and permitting requirements that might affect the demonstration and future application of the technology have been resolved.

6. Programmatic Driver Criterion: Commercial Viability

6.1 Requirement: A preliminary product concept has been defined.

6.1.1 Deliverable: The TD/PI must provide a discussion of the preliminary product concept.

6.2 Requirement: Invention disclosure and intellectual property issues have been identified and protected as appropriate.

6.2.1 Deliverable: The TD/PI must provide evidence that invention disclosures and intellectual property issues have been identified and protected as appropriate.

6.3 Requirement: A preliminary commercialization plan for government and commercial use of this technology must be completed. (Reference the DOE-EM Commercialization Process dated February 2, 1995, prepared by the Global Environmental Technology Enterprise)

6.3.1 Deliverable: The TD/PI must provide evidence of this plan. The plan should include a market assessment.

6.4 Requirement: Private sector partners should have been identified and formal relationships implemented for commercialization of the technology.

6.4.1 Deliverable: The TD/PI must provide evidence that efforts have been made for transfer of the technology to the private sector.

Gate 5—Entrance into Demonstration Stage

The documentation/deliverables for Gate 5 must address the following criteria/requirements. **(New requirements for this Gate are identified in bold letters.)** This documentation should include formal reports (i.e., Innovative Technology Summary Report if a demonstration of the technology is not planned for Stage 6) and plans where applicable and must be identified such that they correspond to the appropriate deliverable. The technical activities' specific contribution to the 10-Year Plan should be identified. The level of detail provided in the deliverables identified in the following should be sufficient to ensure that the requirements reflect the status of the technology as it enters this gate.

1. Programmatic Driver Criterion: Technology End User Need

    1.1 Requirement: Project must be relevant to a defined high-priority DOE environmental management need.
        1.1.1 Deliverable: The TD/PI must show how the proposed technology is tied directly to one or more of these needs.
        1.1.2 Background: The FA/CC/IP Programs will develop a high-priority EM needs list for their respective program from the information gathered on the needs template established by the STCGs. This will include the priority of the need, required implementation dates, baseline technology, performance requirements, and associated costs.

    1.2 Requirement: Research will yield results within a time frame consistent with implementation/deployment needs.
        1.2.1 Deliverable: The TD/PI must provide evidence that the research and development of the technology has a high probability of completion within the required implementation/deployment time frame.
        1.2.2 Background: The required implementation dates for the technology will be provided by the FA/CC/IP.

    1.3 Requirement: Research has been linked to specific end user needs.
        1.3.1 Deliverable: The results of the research to-date must show a direct tie to end user needs. Results should be documented in papers and/or formal reports. Where possible, the technology should show how it fills a gap in availability of needed technology or identify and quantify a potential benefit.
        1.3.2 Background: Specific end user needs are identified and provided by the FA/CC/IP with input from the STCG and site.

    1.4 Requirement: End user performance requirements have been incorporated into the project and implementation issues defined.
        1.4.1 Deliverable: The TD/PI must provide evidence that the end user performance requirements have been addressed in the research and development activities to-date and how they will be met when implemented in the field.
        1.4.2 Background: The end user performance requirements will be provided by the FA/CC/IP as supplied by the STCG.

    1.5 Requirement: The end user of the technology must be committed to deployment if the demonstration performance requirements are met.
        1.5.1 Deliverable: The TD/PI must provide evidence in the form of letters, funding documents, etc., to verify end user deployment of the technology.

1.6 Requirement: The end user of the technology must be a partner in the demonstration of the technology.

1.6.1 Deliverable: The TD/PI must provide evidence that the end user will assume some level of responsibility/participation in the demonstration and share in the cost.

2. Programmatic Driver Criterion: Technical Merit

2.1 Requirement: The scientific and/or technical merit of the project must be well founded.

2.1.1 Deliverable: The description of the technology/process, major elements and support equipment/systems must be discussed in sufficient detail to determine the scientific principles underlying the technology and the technical merits of the project are well founded.

2.2 Requirement: The likelihood is high that the research will lead to new discoveries or have substantial impact on progress in that field.

2.2.1 Deliverable: The TD/PI should emphasize the innovative aspects of the technology and how it would impact the methods currently used in the field.

2.3 Requirement: Proposed methods or approach for demonstration and implementation are scientifically based.

2.3.1 Deliverable: The TD/PI must discuss the scientific bases for moving the technology from proof of principal and laboratory-scale experimentation to laboratory-scale prototyping.

2.4 Requirement: Potential technical advantage(s) over baseline and alternative technologies are defined and documented.

2.4.1 Deliverable: The TD/PI must provide evidence that the technology has technical advantages over the baseline technologies.

2.4.2 Background: The baseline technology will be provided by the FA/CC/IP in concert with the STCG and site.

2.5 Requirement: Evidence must be provided that technical feasibility has been demonstrated and that it will meet performance requirements. This evidence should include summaries of proof of principal and/or laboratory-scale experimentation.

2.5.1 Deliverable: The results to date from proof of principal and laboratory-scale experimentation should provide evidence that the technology will meet the requirement of the end user. Clear and direct scale-up capability for future prototype and full-scale demonstrations and implementation must be provided**.**

2.5.2 Background: The end user performance requirements will be provided by the FA/CC/IP in concert with the STCG and site**.**

2.6 Requirement: Proof of the design of the technology application is required.

2.6.1 Deliverable: The TD/IP must provide evidence that the design of the technology for application has been completed. Evidence may include full-scale laboratory testing results, preliminary field testing results, technical specifications, and infrastructure development plans.

2.7 Requirement: The system to demonstrate the technology in the field must be fully engineered.

2.7.1 Deliverable: The TD/PI must provide details of the full-scale design. This should include drawings, schematics, design, and procurement specifications.

3. Programmatic Driver Criterion: Cost

3.1 Requirement: Proposed budget for the research is reasonable and appropriate.

3.1.1 Deliverable: The TD/PI must provide an estimated budget for the life of the project on an annual basis. Funding expectations from all major organization (private sector, DOE, and other governmental organizations) and funding contributions for labor, services, materials, and process equipment must be provided.

3.2 Requirement: Preliminary cost estimates reflecting advantages over the cost of baseline and alternative technologies must be provided.

3.2.1 Deliverable: The TD/PI must discuss the methodology and basic assumptions used in comparing the technology with the baseline and/or alternative technologies.

3.2.2 Background: Baseline cost information will be provided to the TD/PI by the FA/CC/IP with input from the STCGs and sites. In developing cost analysis information please refer to the **"**Cost Savings Deliverables and Criteria for the OST Technology Decision Process" listed as a reference document in Attachment A of this procedure.

3.3 Requirement: There must be a cost benefit associated with continued investment in the research and development of this technology.

3.3.1 Deliverable: The TD/PI must provide evidence of cost savings/cost avoidance and return on investment through use of this technology. For return on investment calculations, the discount rates established in Appendix C of OMB Circular No. A-94, which is up-dated annually, may be used.

3.4 Requirement: Life-cycle cost estimates reflecting the advantages of this technology over the baseline and other emerging technologies must be provided.

3.4.1 Deliverable: The TD/PI and the FA/CC/IP must provide a life-cycle cost study that reflects advantages of this technology over the baseline and other emerging technologies.

3.5 Requirement: Capital costs associated with the full-scale demonstration system must be provided.

3.5.1 Deliverable: The TD/PI must provide a complete breakdown of all costs associated with the full-scale demonstration system.

4. Programmatic Driver Criterion: Safety, Health, Environmental Protection, and Risk

4.1 Requirement: The research must present a solution that meets or exceeds current safety, health, and environmental protection levels and meets or reduces the risk to the public, workers, and the environment during operation in comparison to baseline and alternative technologies.

4.1.1 Deliverables: The TD/PI must discuss how the research to date has demonstrated the likelihood that safety, health, and environmental protection levels will be maintained or exceeded and that risk to the public, workers, and the environment will be maintained or reduced.

4.1.2 Background: The baseline technology will be provided by FA/CC/IP in concert with the STCG and site.

4.2 Requirement: Safety, health, and environmental protection issues have been defined and are incorporated into the research and development documents and activities.

4.2.1 Deliverable: The TD/PI must provide evidence that these issues have been included in documentation and activities relevant to continuation of the research and development.

4.3 Requirement: Failure scenarios must be defined and contingency plans developed.

4.3.1 Deliverables: The TD/PI must provide evidence that failure scenarios for research, development, demonstration, and implementation have been defined and contingency plans developed to address these scenarios.

5. Programmatic Driver Criterion: Stakeholder, Regulator, and Tribal Issues

5.1 Requirement: Stakeholder, regulator, and tribal issues associated with similar technologies have been identified and assessed.
5.1.1 Deliverable: The TD/PI must provide evidence that each of the issues associated with similar technologies under this driver criterion have been identified and assessed.
5.1.2 Background: The FA/CC/IP, with support from the STCGs and the sites, will provide input for these issues.

5.2 Requirement: Appropriate notification and permitting requirements must be identified.
5.2.1 Deliverable: The TD/PI must provide evidence that notification and permitting requirements for use of the technology have been identified.

5.3 Requirement: Stakeholder, regulator, and tribal issues for this technology have been identified.
5.3.1 Deliverable: The TD/PI must provide evidence that stakeholder, regulator, and tribal compliance issues relative to this technology have been identified.
5.3.2 Background: Reference the Cal: Progress in Motion," California Environmental Technology Certification Program, Vol. 5/No. 12 and the Amendment to the Memorandum of Understanding for the Evaluation and Promotion of Environmental Technologies dated June 4, 1996.

5.4 Requirement: Strategies for resolving stakeholder, regulatory, tribal issues, and permit requirements must be completed.
5.4.1 Deliverable: The TD/PI, in concert with the FA/CC/IP, STCG and the site, must provide evidence that stakeholder, regulatory, and tribal issues and permitting requirements that might affect the demonstration and future application of the technology have been resolved.

5.5 Requirement: All required notifications, documentation, and permits for the full-scale demonstration and deployment of the technology in the field have been completed.
5.5.1 Deliverable: The TD/PI must provide evidence that all required notifications, documentation, and permits have been completed.

6. Programmatic Driver Criterion: Commercial Viability

6.1 Requirement: A preliminary product concept has been defined.
6.1.1 Deliverable: The TD/PI must provide a discussion of the preliminary product concept.

6.2 Requirement: Invention disclosure and intellectual property issues have been identified and protected as appropriate.
6.2.1 Deliverable: The TD/PI must provide evidence that invention disclosures and intellectual property issues have been identified and protected as appropriate.

6.3 Requirement: A preliminary commercialization plan for government and commercial use of this technology must be completed. (Reference the DOE-EM Commercialization Process dated February 2,1995, prepared by the Global Environmental Technology Enterprise)
6.3.1 Deliverable: The TD/PI must provide evidence of this plan. The plan should include a market assessment.

6.4 Requirement: Private sector partners should have been identified and formal relationships implemented for commercialization of the technology.

6.4.1 Deliverable: The TD/PI must provide evidence that efforts have been made for transfer of the technology to the private sector.

6.5 Requirement: Transfer of the technology to the private sector must be completed.

6.5.1 Deliverable: The TD/PI must provide evidence of the transfer of the technology to the private sector.

Gate 6—Entrance into Implementation Stage

The documentation/deliverables for Gate 6 must address the following criteria/requirements. Technologies/systems considered for passage through this gate must have passed the requirements identified for Gate 5. **(New requirements for this Gate are identified in bold letters.)** This documentation should include formal reports (i.e., Innovative Technology Summary Report if a demonstration was performed in Stage 6; a Cost and Performance Report for Environmental Remediation Projects shall also be prepared for EM-40 funded technologies passing through this gate) and plans where applicable and must be identified such that they correspond to the appropriate deliverable. The technical activities' specific contribution to the 10-Year Plan should be identified. The level of detail provided in the deliverables identified below should be sufficient to ensure that the requirements reflect the status of the technology as it enters this gate.

1. Programmatic Driver Criterion: Technology End User Need

    1.1 Requirement: Project must be relevant to a defined high-priority DOE environmental management need.
        1.1.1 Deliverable: The TD/PI must show how the proposed technology is tied directly to one or more of these needs.
        1.1.2 Background: The FA/CC/IP Programs will develop a high-priority EM needs list for their respective program from the information gathered on the needs template established by the STCGs. This will include the priority of the need, required implementation dates, baseline technology, performance requirements, and associated costs.

    1.2 Requirement: Research will yield results within a time frame consistent with implementation/deployment needs.
        1.2.1 Deliverable: The TD/PI must provide evidence that the research and development of the technology has a high probability of completion within the required implementation/deployment time frame.
        1.2.2 Background: The required implementation dates for the technology will be provided by the FA/CC/IP.

    1.3 Requirement: Research has been linked to specific end user needs.
        1.3.1 Deliverable: The results of the research to-date must show a direct tie to end user needs. Results should be documented in papers and/or formal reports. Where possible, the technology should show how it fills a gap in availability of needed technology or identify and quantify a potential benefit.
        1.3.2 Background: Specific end user needs are identified and provided by the FA/CC/IP with input from the STCG and site.

    1.4 Requirement: End user performance requirements have been incorporated into the project and implementation issues defined.
        1.4.1 Deliverable: The TD/PI must provide evidence that the end user performance requirements have been addressed in the research and development activities to-date and how they will be met when implemented in the field.
        1.4.2 Background: The end user performance requirements will be provided by the FA/CC/IP as supplied by the STCG.

    1.5 Requirement: The end user of the technology must be committed to deployment if the demonstration performance requirements are met.

1.5.1 Deliverable: The TD/PI must provide evidence in the form of letters, funding documents, etc., to verify end user deployment of the technology.

1.6 Requirement: The end user of the technology must be a partner in the demonstration of the technology.

1.6.1 Deliverable: The TD/PI must provide evidence that the end user will assume some level of responsibility/participation in the demonstration and share in the cost.

1.7 Requirement: The technology must have been proven applicable to identified end-user needs.

1.7.1 Deliverable: The TD/PI must provide the successful results of the demonstration.

2. Programmatic Driver Criterion: Technical Merit

2.1 Requirement: The scientific and/or technical merit of the project must be well founded.

2.1.1 Deliverable: The description of the technology/process, major elements and support equipment/systems must be discussed in sufficient detail to determine the scientific principles underlying the technology and the technical merits of the project are well founded.

2.2 Requirement: The likelihood is high that the research will lead to new discoveries or have substantial impact on progress in that field.

2.2.1 Deliverable: The TD/PI should emphasize the innovative aspects of the technology and how it would impact the methods currently used in the field.

2.3 Requirement: Proposed methods or approach for demonstration and implementation are scientifically based.

2.3.1 Deliverable: The TD/PI must discuss the scientific bases for moving the technology from proof of principal and laboratory-scale experimentation to laboratory-scale prototyping.

2.4 Requirement: Potential technical advantage(s) over baseline and alternative technologies are defined and documented.

2.4.1 Deliverable: The TD/PI must provide evidence that the technology has technical advantages over the baseline technologies.

2.4.2 Background: The baseline technology will be provided by the FA/CC/IP in concert with the STCG and site.

2.5 Requirement: Evidence must be provided that technical feasibility has been demonstrated and that it will meet performance requirements. This evidence should include summaries of proof of principal and/or laboratory-scale experimentation.

2.5.1 Deliverable: The results to date from proof of principal and laboratory-scale experimentation should provide evidence that the technology will meet the requirement of the end user. Clear and direct scale-up capability for future prototype and full-scale demonstrations and implementation must be provided**.**

2.5.2 Background: The end user performance requirements will be provided by the FA/CC/IP in concert with the STCG and site**.**

2.6 Requirement: Proof of the design of the technology application is required.

2.6.1 Deliverable: The TD/IP must provide evidence that the design of the technology for application has been completed. Evidence may include full-scale laboratory testing results, preliminary field testing results, technical specifications, and infrastructure development plans.

2.7 Requirement: The system to demonstrate the technology in the field must be fully engineered.
2.7.1 Deliverable: The TD/PI must provide details of the full-scale design. This should include drawings, schematics, design, and procurement specifications.

2.8 Requirement: The technical performance requirements have been met.
2.8.1 Deliverable: The TD/PI must provide a summary of the demonstration results that provides evidence of the technical merit of the technology.

3. Programmatic Driver Criterion: Cost

3.1 Requirement: Proposed budget for the research is reasonable and appropriate.
3.1.1 Deliverable: The TD/PI must provide an estimated budget for the life of the project on an annual basis. Funding expectations from all major organization (private sector, DOE, and other governmental organizations) and funding contributions for labor, services, materials, and process equipment must be provided.

3.2 Requirement: Preliminary cost estimates reflecting advantages over the cost of baseline and alternative technologies must be provided.
3.2.1 Deliverable: The TD/PI must discuss the methodology and basic assumptions used in comparing the technology with the baseline and/or alternative technologies.
3.2.2 Background: Baseline cost information will be provided to the TD/PI by the FA/CC/IP with input from the STCGs and sites. In developing cost analysis information please refer to the **"**Cost Savings Deliverables and Criteria for the OST Technology Decision Process" listed as a reference document in Attachment A of this procedure.

3.3 Requirement: There must be a cost benefit associated with continued investment in the research and development of this technology.
3.3.1 Deliverable: The TD/PI must provide evidence of cost savings/cost avoidance and return on investment through use of this technology. For return on investment calculations, the discount rates established in Appendix C of OMB Circular No. A-94, which is up-dated annually, may be used.

3.4 Requirement: Life-cycle cost estimates reflecting the advantages of this technology over the baseline and other emerging technologies must be provided.
3.4.1 Deliverable: The TD/PI and the FA/CC/IP must provide a life-cycle cost study that reflects advantages of this technology over the baseline and other emerging technologies.

3.5 Requirement: Capital costs associated with the full-scale demonstration system must be provided.
3.5.1 Deliverable: The TD/PI must provide a complete breakdown of all costs associated with the full-scale demonstration system.

3.6 Requirement: Cost factors including return on investment (ROI) and budget estimates have been verified.
3.6.1 Deliverable: The TD/PI must provide evidence that the ROI and budget estimates are within the parameters agreed upon by the end user.

3.7 Requirement: Funds must be appropriated for implementation/deployment of the technology.
3.7.1 Deliverable: The TD/PI must provide evidence that the end user has funded the technology for implementation/deployment.

4. Programmatic Driver Criterion: Safety, Health, Environmental Protection, and Risk

4.1 Requirement: The research must present a solution that meets or exceeds current safety, health, and environmental protection levels and meets or reduces the risk to the public, workers, and the environment during operation in comparison to baseline and alternative technologies.
4.1.1 Deliverables: The TD/PI must discuss how the research to date has demonstrated the likelihood that safety, health, and environmental protection levels will be maintained or exceeded and that risk to the public, workers, and the environment will be maintained or reduced.
4.1.2 Background: The baseline technology will be provided by FA/CC/IP in concert with the STCG and site.

4.2 Requirement: Safety, health, and environmental protection issues have been defined and are incorporated into the research and development documents and activities.
4.2.1 Deliverable: The TD/PI must provide evidence that these issues have been included in documentation and activities relevant to continuation of the research and development.

4.3 Requirement: Failure scenarios must be defined and contingency plans developed.
4.3.1 Deliverables: The TD/PI must provide evidence that failure scenarios for research, development, demonstration, and implementation have been defined and contingency plans developed to address these scenarios.

4.4 Requirement: All safety, health, environmental protection, and risk documentation and plans have been successfully completed in accordance with the appropriate requirements.
4.4.1 Deliverables: The TD/PI will provide a summary report of all safety, health, environmental protection, and risk issues associated with the technology. Criticality documentation and safety analysis shall be addressed.

5. Programmatic Driver Criterion: Stakeholder, Regulator, and Tribal Issues

5.1 Requirement: Stakeholder, regulator, and tribal issues associated with similar technologies have been identified and assessed.
5.1.1 Deliverable: The TD/PI must provide evidence that each of the issues associated with similar technologies under this driver criterion have been identified and assessed.
5.1.2 Background: The FA/CC/IP, with support from the STCGs and the sites, will provide input for these issues.

5.2 Requirement: Appropriate notification and permitting requirements must be identified.
5.2.1 Deliverable: The TD/PI must provide evidence that notification and permitting requirements for use of the technology have been identified.

5.3 Requirement: Stakeholder, regulator, and tribal issues for this technology have been identified.
5.3.1 Deliverable: The TD/PI must provide evidence that stakeholder, regulator, and tribal compliance issues relative to this technology have been identified.
5.3.2 Background: Reference the Cal: Progress in Motion," California Environmental Technology Certification Program, Vol. 5/No. 12 and the Amendment to the Memorandum of Understanding for the Evaluation and Promotion of Environmental Technologies dated June 4, 1996.

5.4 Requirement: Strategies for resolving stakeholder, regulatory, tribal issues, and permit requirements must be completed.
5.4.1 Deliverable: The TD/PI, in concert with the FA/CC/IP, STCG and the site, must provide evidence that stakeholder, regulatory, and tribal issues and permitting

requirements that might affect the demonstration and future application of the technology have been resolved.

5.5 Requirement: All required notifications, documentation, and permits for the full-scale demonstration and deployment of the technology in the field have been completed.
5.5.1 Deliverable: The TD/PI must provide evidence that all required notifications, documentation, and permits have been completed.

5.6 Requirement: All relevant stakeholder, regulatory protection, and tribal issues have been successfully addressed. All documents and permits, including appropriate National Environmental Policy Act, requirements have been completed.
5.6.1 Deliverable: The TD/PI must provide evidence that all appropriate documentation and permits have been obtained for implementation/deployment of the technology to the field.

6. Programmatic Driver Criterion: Commercial Viability

6.1 Requirement: A preliminary product concept has been defined.
6.1.1 Deliverable: The TD/PI must provide a discussion of the preliminary product concept.

6.2 Requirement: Invention disclosure and intellectual property issues have been identified and protected as appropriate.
6.2.1 Deliverable: The TD/PI must provide evidence that invention disclosures and intellectual property issues have been identified and protected as appropriate.

6.3 Requirement: A preliminary commercialization plan for government and commercial use of this technology must be completed. (Reference the DOE-EM Commercialization Process dated February 2,1995, prepared by the Global Environmental Technology Enterprise)
6.3.1 Deliverable: The TD/PI must provide evidence of this plan. The plan should include a market assessment.

6.4 Requirement: Private sector partners should have been identified and formal relationships implemented for commercialization of the technology.
6.4.1 Deliverable: The TD/PI must provide evidence that efforts have been made for transfer of the technology to the private sector.

6.5 Requirement: Transfer of the technology to the private sector must be completed.
6.5.1 Deliverable: The TD/PI must provide evidence of the transfer of the technology to the private sector.

6.6 Requirement: The product concept must be clearly defined via specifications drawings, etc. All intellectual property, including patent and license agreements, have been completed. A commercialization plan that includes a market assessment and a summary of competing technologies must be completed. A private sector partner must be in place.
6.6.1 Deliverable: The TD/PI must provide evidence that the product is clearly defined, that all intellectual property (including patent and license agreements) are protected, that a commercialization plan has been completed, and that a private sector partner is involved with the technology.

ATTACHMENT E

REQUIREMENTS AND DELIVERABLES MATRIX
(NEW GATE REQUIREMENTS ARE BOLD)

Requirement	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6
TECHNOLOGY END-USER NEED						
Project must be relevant to a defined high-priority DOE environmental management need.	**Yes**	Yes	Yes	Yes	Yes	Yes
Research will yield results within a time frame consistent with implementation/deployment needs.	**Yes**	Yes	Yes	Yes	Yes	Yes
Research has been linked to specific end-user needs.		**Yes**	Yes	Yes	Yes	Yes
End-user performance requirements have been incorporated into the project and implementation issues defined.			**Yes**	Yes	Yes	Yes
The end user of the technology must be committed to deployment if the demonstration performance requirements are met.					**Yes**	Yes
The end user of the technology must be a partner in the demonstration of the technology.					**Yes**	Yes
The technology must have been proven applicable to identified end-user needs.						**Yes**
TECHNICAL MERIT						
The scientific and/or technical merit of the project must be well founded.	**Yes**	Yes	Yes	Yes	Yes	Yes
The likelihood is high that the research will lead to new discoveries or have substantial impact on progress in that field.	**Yes**	Yes	Yes	Yes	Yes	Yes
Proposed methods or approach for demonstration and implementation are scientifically based.	**Yes**	Yes	Yes	Yes	Yes	Yes
Potential technical advantage(s) over baseline and alternative technologies must be well defined.	**Yes**					
Potential technical advantage(s) over baseline and alternative technologies are defined and documented.		**Yes**	Yes	Yes	Yes	Yes
Evidence must be provided that technical feasibility has been demonstrated and that it will meet performance requirements. This evidence should include summaries of proof-of-principal and/or laboratory-scale experimentation.		**Yes**	Yes	Yes	Yes	Yes
Proof of the design of the technology application is required.				**Yes**	Yes	Yes
The system to demonstrate the technology in the field must be fully engineered.					**Yes**	Yes
The technical performance requirements have been met.						**Yes**
COST						

REQUIREMENTS AND DELIVERABLES MATRIX

Requirement	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6
The proposed budget for research is reasonable.	**Yes**					
Proposed budget for the research is reasonable and appropriate.		**Yes**	Yes	Yes	Yes	Yes
Preliminary cost estimates reflecting advantages over the cost of baseline and alternative technologies must be provided.		**Yes**	Yes	Yes	Yes	Yes
There must be a cost benefit associated with continued investment in the research and development of this technology.			**Yes**	Yes	Yes	Yes
Life-cycle cost estimates reflecting the advantages of this technology over the baseline and other emerging technologies must be provided.				**Yes**	Yes	Yes
Capital costs associated with the full-scale demonstration system must be provided.					**Yes**	Yes
Cost factors including return on investment (ROI) and budget estimates have been verified.						**Yes**
Funds must be appropriated for implementation/ deployment of the technology.						**Yes**
SAFETY, HEALTH, ENVIRONMENTAL PROTECTION, AND RISK						
The research must present a solution that meets or exceeds current safety, health, and environmental protection levels and meets or reduces the risk to the public, workers, and the environment during operation in comparison to baseline and alternative technologies.	**Yes**	Yes	Yes	Yes	Yes	Yes
Safety, health, and environmental protection issues have been defined and are incorporated into the research and development documents and activities.			**Yes**	Yes	Yes	Yes
Failure scenarios must be defined and contingency plans developed.				**Yes**	Yes	Yes
All safety, health, environmental protection, and risk documentation and plans have been successfully completed in accordance with the appropriate requirements.						**Yes**
STAKEHOLDER, REGULATORY PROTECTION, AND TRIBAL ISSUES						
Stakeholder, regulator, and tribal issues associated with similar technologies have been identified and assessed.		**Yes**	Yes	Yes	Yes	Yes
Appropriate notification and permitting requirements must be identified.		**Yes**	Yes	Yes	Yes	Yes
Stakeholder, regulator, and tribal issues for this technology have been identified.			**Yes**	Yes	Yes	Yes

Requirement	Gate 1	Gate 2	Gate 3	Gate 4	Gate 5	Gate 6
Strategies for resolving stakeholder, regulatory, and tribal issues and permit requirements must be completed.				**Yes**	Yes	Yes
All required notifications, documentation, and permits for the full-scale demonstration and deployment of the technology in the field have been completed.					**Yes**	Yes
All relevant stakeholder, regulatory protection, and risk issues have been successfully addressed. All documents and permits, including appropriate National Environmental Policy Act requirements, have been completed.						**Yes**
COMMERCIAL VIABILITY						
A preliminary product concept has been defined.		**Yes**	Yes	Yes	Yes	Yes
Invention disclosure and intellectual property issues have been identified and protected as appropriate.		**Yes**	Yes	Yes	Yes	Yes
A preliminary commercialization plan for government and commercial utilization of this technology must be completed.			**Yes**	Yes	Yes	Yes
Private sector partners should have been identified and formal relationships implemented for commercialization of the technology.				**Yes**	Yes	Yes
Transfer of the technology to the private sector must be completed.					**Yes**	Yes
The product concept must be clearly defined via specifications drawings, etc. All intellectual property, including patent and license agreements, have been completed. A commercialization plan that includes a market assessment and a summary of competing technologies must be completed. A private sector partner must be in place.						**Yes**